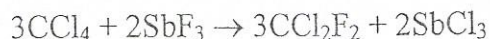# Multiple Choice

1) When 5.14 g of the hydrated magnesium sulfate $MgSO_4.xH_2O$ are heated till all its water of crystallization is driven off 2.51 g of the anhydrous $MgSO_4$ are obtained. Calculate the value of x (the number of the water molecules combined in the hydrated form). .

(A) A)   7   B)   5   C)   3   D)   10

2) For the manufacture of Freon-12 gas CCl_2F_2 according to:

$$3CCl_4 + 2SbF_3 \rightarrow 3CCl_2F_2 + 2SbCl_3$$

146.0 kg of SbF_3 were allowed to react with 200.0 kg of CCl_4. After the reaction was finished, 120.0 kg of CCl_2F_2 were obtained. Calculate the percentage yield of CCl_2F_2?

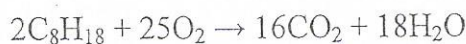**(B)** A)   79%   B)   81%   C)   85%   D)   77%

3) Automotive air bags inflate when sodium azide NaN_3 decomposes to its constituent elements:

$$2NaN_3(s) \rightarrow 2Na(s) + 3N_2(g)$$

How many grams of NaN_3 are required to inflate an air bag by 70.0 L of N_2 at 35°C and 1.0 atm pressure?

(C) A)   110   B)   105   C)   120   D)   100

4) The mass, in g, of water produced as a result of combusting 27.3 g of C_8H_{18} is:

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$$

(C) A)   30.25   B)   32.17   C)   38.75   D)   29.32

5) The mass, in g, of $Mg(NO_3)_2$ in 150 mL of 2.2 M aqueous solution of $Mg(NO_3)_2$ is:

(A) A)   48.95   B)   35.65   C)   25.65   D)   55.65

6) The mole fraction of HCl in an aqueous solution that is 36.46% HCl by mass is:

(D) A)   0.25   B)   0.31   C)   0.35   D)   0.22

7) For a gas, if "P × V" does not equal "n × R × T" (deviation from the ideal gas law is pronounced), which of the following could be the reason:
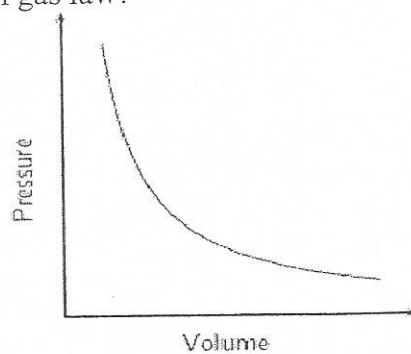
     A)   the attractions between the gas particles are very small.
     B)   the temperature of the gas is very low.
(B)   C)   the pressure of the gas is very low.
     D)   the volumes of the gas particles are very small.

8) The diagram on the right is a graphical presentation of which gas law?

A) Boyle's law

B) Charles law

A

C) Graham's law

D) Avogadro's law

Pressure

Volume

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9) Which of the following gases effuses about two times faster than $SO_2(g)$?

D

A) O_2 B) CO_2 C) CO   D) CH_4

① $MgSO_4 \cdot XH_2O \xrightarrow{\triangle} MgSO_4$

514 $\longrightarrow$ 2.51

∴ mass of H_2O = 514 - 2.51 = 2.63 g

moles of $MgSO_4 = \dfrac{2.51}{120.3} = 0.021$ moles $\Rightarrow$ 1

moles of $H_2O = \dfrac{2.63}{18} = 0.146$ moles $\Longrightarrow$ 7

$Mg\,SO_4 \cdot 7H_2O$

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② actual Yield = 120 Kg of CCl_2F_2

Mwt of CCl_2F_2 = 12 + 35.5 × 2 + 19 × 2 = 121 g/mol
Mwt of SbF_3 = 121.8 + 19 × 3 = 178.8 g/mol
Mwt of CCl_4 = 12 + 35.5 × 4 = 154 g/mol

Antimony trifluoride
moles of $SbF_3 = \dfrac{146,000}{178.8} = 816.55$ moles
moles of $CCl_4 = \dfrac{200,000}{154} = 1298.70$ moles

The limiting reactant is SbF_3
from Chemical equation

2 $\longrightarrow$ 3
816.55 $\longrightarrow$ x = 1224.83 moles

m = Mwt . n
= 121 × 1224.83 = 148203.83 g = 148.204 Kg

%Yield = $\dfrac{actual\ Yield}{theoritical\ Yield}$ = $\dfrac{120}{148.2}$ × 100 = 81 %

1

③

$PV = nRT$

$V = 70 L$

$T = 35 + 273 = 308 K$

$P = 1 \, atm$

$n = \dfrac{PV}{RT} = \dfrac{70 \times 1}{0.082 \times 308} = 2.77 \text{ moles of } N_2$

$2 \longrightarrow 3$

$X \longrightarrow 2.77 \text{ moles}$

$X = 1.85 \text{ moles of } NaN_3$

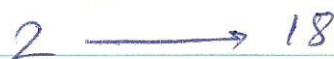$Mwt \text{ of } NaN_3 = 23 + 14 \times 3 = 65 \, g/mol$

$m = n \cdot Mwt = 1.85 \times 65 = 120.25 \, g$

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④ $Mwt \text{ of } C_8H_{18} = 114 \, g/mol$

$\text{moles of } C_8H_{18} = \dfrac{27.3}{114} = 0.24 \text{ moles.}$

from chemical equation

$2 \longrightarrow 18$

$0.24 \longrightarrow X = 2.16 \text{ moles.}$

$m = n \cdot Mwt$

$= 2.16 \times 18 = 38.88 \, g$

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⑤ $M = 2.2 M \text{ or } 2.2 \, mol/L$

$V = 150 \, ml = 0.150 \, L$

$M = \dfrac{n}{V} \quad \therefore \quad n = M \cdot V = 2.2 \times 0.150$

$= 0.33 \text{ moles}$

$m = n \cdot Mwt \quad , \quad Mwt = 24.3 + (14 + 16 \times 3) \times 2 = 148.3 \, g/mol$

$m = 0.33 \times 148.3 = 48.94 \, g$

2

(6) 36.46 g of HCl

$100 - 36.46 g = 63.54 g$ of H_2O

moles of $HCl = \dfrac{36.46}{36.5} \approx 1$

moles of $H_2O = \dfrac{63.54}{18} = 3.53$ moles

$$X_{HCl} = \frac{n_{HCl}}{n_{HCl} + n_{H_2O}} = \frac{1}{1 + 3.53} = 0.22$$

(9) Graham's law

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\frac{r_X}{r_{SO_4}} = 2$$

$$\sqrt{\frac{M_{SO_4}}{M_X}} = 2 \implies \sqrt{\frac{64}{M_X}} = 2$$

$$\frac{64}{M_X} = 4 \qquad M_X = \frac{64}{4} = 16 \text{ g/mol}$$

$$\therefore CH_4 = 12 + 4 = 16 \text{ g/mol}$$